Data report on Baskarp Sand No. 15

2018 Delivery

Nielsen, Søren Dam; Nielsen, Benjaminn Nordahl

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by

Søren Dam Nielsen
Benjaminn Nordahl Nielsen

Tests conducted by

Anette Næslund Pedersen

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Resume

2018 Delivery

In the geotechnical laboratory at Aalborg University, small-scale tests have been performed on various foundations for many years. As the Laboratory moved to a new location (Thomas Manns Vej 23, 9220 Aalborg Ø), the sand in all existing set-ups were removed. The material used in the past were a delivery of Baskarp Sand No. 15 from 1993. To replace the sand, a new delivery of Baskarp Sand No. 15, were delivered in 2018. Representative samples from the new delivery has been tested in the geotechnical laboratory at Aalborg University, and the results are described in this report.

Baskarp Sand

Baskarp sand no. 15 is delivered from Sibelco Nordic AB, Sweeden.

Resume

Parameter	symbol	value	Unit
Water content	w	3	%
Specific gravity	G_s	2.63	-
Minimum void ratio	e_{max}	0.84	-
Maximum void ratio	e_{min}	0.56	-
Coefficient of uniformity	U	1.52	-
Angle of repose	φ	$30,1$	°
Permeability	K	$1.061 \cdot 10^{-5}$	$\mathrm{m^s/s}$

Performed tests

This data report presents results from the following geotechnical tests:

- Classification Tests (CLA)
    - Water content
    - Sieve test
    - Specific Gravity
    - Maximum void ratio
    - Minimum void ratio
    - Angle of repose
- Falling Head (FAH)

Classification

Water Content

The water content of the sand I calculated as

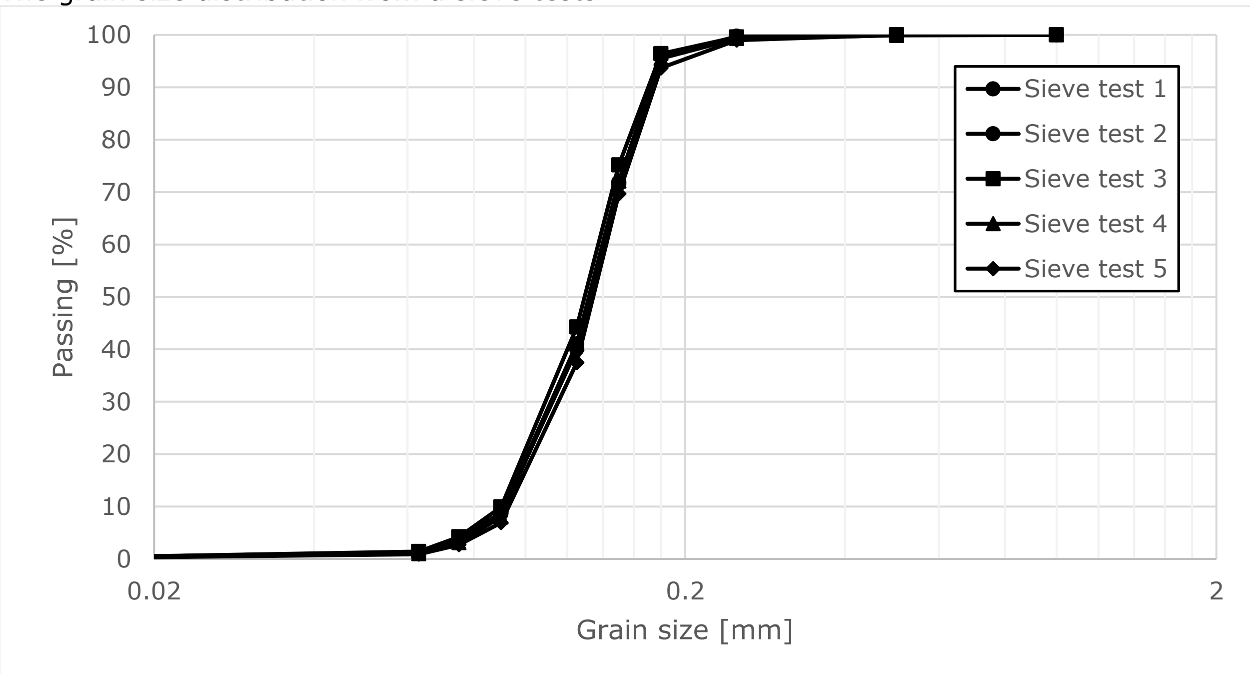
$$w = \frac{m_w}{m_s}$$

m_w is the mass of water and m_s is the mass of the solids (the soil grains).

Test no.	1	2	3	4	5
Water content, w %	0,04	0,04	0,05	0,04	0,04

Sieve Test

The grain size distribution from a sieve tests



Test no.	1	2	3	4	5
d_{10}	0.0913	0.0915	0.0901	0.0921	0.0935
d_{50}	0.1323	0.1329	0.1297	0.1322	0.1347
d_{60}	0.1404	0.1408	0.1377	0.1403	0.1425
$U = \frac{d_{60}}{d_{10}}$	1.54	1.54	1.50	1.52	1.52

Specific Gravity

The specific gravity is calculated as

$$G_s = \frac{\gamma_s}{\gamma_0}$$

where γ_s is the unit weight of the solid part (soil grain) and γ_0 is the unit weight of pure (demineralized) water at 4°C.

Test no.	1	2	3	4	5
G_s	2,63	2,63	2,63	2,63	2,63

Maximum and Minimum Void Ratio

The maximum void ratio is calculated as

$$e_{max} = \frac{G_s \rho_w V_{cyl}}{m_s} - 1 \text{ and } e_{min} = \frac{G_s \rho_w V_{cyl}}{m_s} - 1$$

where G_s is the specific gravity, ρ_w is the density of water, V_{cyl} is the volume of the cylinder.

Test no.	1	2	3	4	5
Minimum void ratio, e_{min}	0,853	0,844	0,836	0,846	0,836
Maximum void ratio, e_{max}	0,561	0,556	0,564	0,567	0,563

Angle of repose

Test no.	1	2	3	4	5	6	7	8	9	10
Angle of repose	30,5°	30,5°	31,0°	30,0°	30,0°	30,0°	29,0°	30,0°	30,0°	30,0°

Hydraulic conductivity

The hydraulic conductivity *k* has been determined from a series of falling head tests in the geotechnical laboratory at Aalborg University. The dry unit weight were measured with a water content of 3%. Nine falling head tests have been performed, and the results are presented in Table 1. From the average value of the permeability (presented in the resume), the hydraulic conductivity is calculated as a function of temperature and is shown in Figure 1.

Table 1: Results from falling head.

Test No.	Dry unit weight γ_d [kN/m^3]	Hydraulic conductivity k_T [m/s]	Temperature T [°C]	Kinematic viscosity ν_T [m^2/s]	Permeability K [m^2]
FAH0101	13.6	$1.12 \cdot 10^{-4}$	23.0	0.9352	$1.06 \cdot 10^{-5}$
FAH0102	13.9	$1.03 \cdot 10^{-4}$	23.2	0.9320	$0.98 \cdot 10^{-5}$
FAH0103	13.7	$1.05 \cdot 10^{-4}$	23.5	0.9254	$0.99 \cdot 10^{-5}$
FAH0104	13.7	$1.08 \cdot 10^{-4}$	23.5	0.9244	$1.02 \cdot 10^{-5}$
FAH0105	13.8	$1.07 \cdot 10^{-4}$	22.3	0.9515	$1.04 \cdot 10^{-5}$
FAH0106	13.8	$1.08 \cdot 10^{-4}$	22.3	0.9504	$1.04 \cdot 10^{-5}$
FAH0107	13.9	$1.05 \cdot 10^{-4}$	22.3	0.9471	$1.01 \cdot 10^{-5}$
FAH0108	13.7	$1.07 \cdot 10^{-4}$	21.4	0.9722	$1.06 \cdot 10^{-5}$
FAH0109	13.9	$0.89 \cdot 10^{-4}$	22.5	0.9471	$0.86 \cdot 10^{-5}$

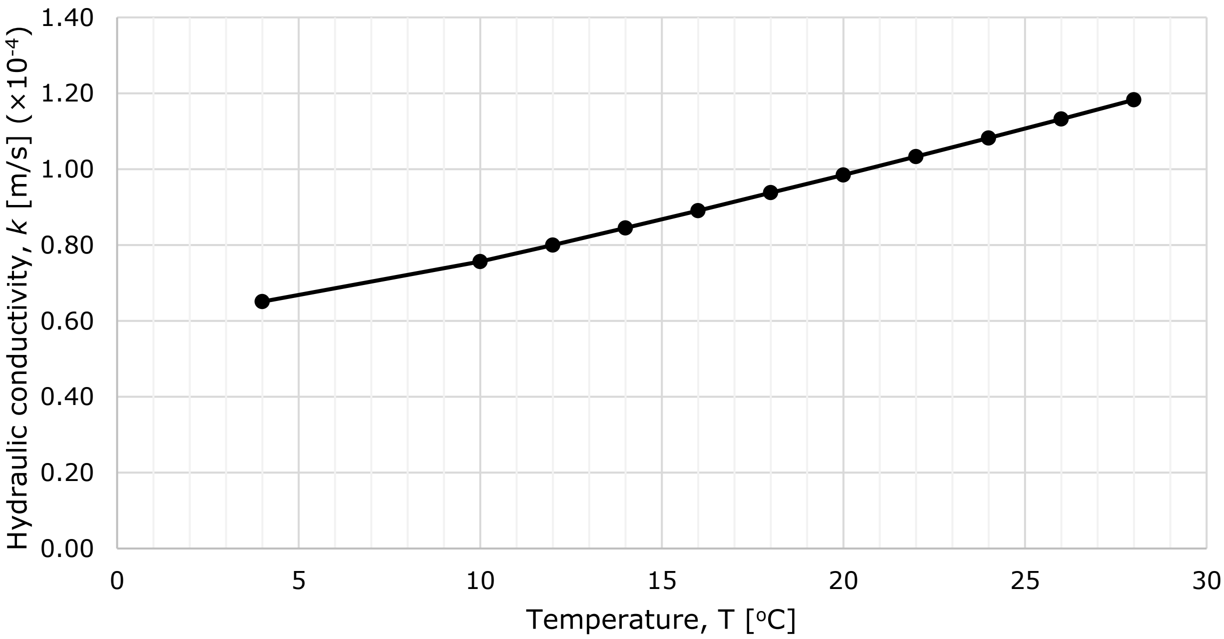


Figure 1: Hydraulic conductivity as a function of temperature.

Appendix

(OBS! Appendix in Danish)

Maximum and Minimum Void Ratio

LØS LEJRING 1

Prøve	nr	1	1	1
A (10,0/ 38,48)	cm^2	10	10	10
h (7,0/14,4)	cm	7	7	7
V (70,0/554,0)	cm^3	70	70	70
Cyl. + W_s	g	338,32	337,46	338,51
Cyl.	g	238,72	238,72	238,71
W_s	g	99,60	98,74	99,80
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,8484	0,8645	0,8447

FAST LEJRING 1

Prøve	nr	1	1	1
A (10,0/38,48)	cm^2	10	10	10
h	cm	5,775	5,790	5,790
V	cm^3	57,75	57,90	57,90
Cyl. + W_s	g	336,09	336,26	336,26
Cyl.	g	238,71	238,71	238,71
W_s	g	97,38	97,55	97,55
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,5597	0,5610	0,5610

LØS LEJRING 2

Prøve	nr	2	2	2
A (10,0/ 38,48)	cm^2	10	10	10
h (7,0/14,4)	cm	7	7	7
V (70,0/554,0)	cm^3	70	70	70
Cyl. + W_s	g	338,38	338,60	338,68
Cyl.	g	238,70	238,70	238,70
W_s	g	99,68	99,90	99,98
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,8469	0,8428	0,8414

FAST LEJRING 2

Prøve	nr	2	2	2
A (10,0/38,48)	cm^2	10	10	10
h	cm	5,800	5,815	5,820
V	cm^3	58,00	58,15	58,20
Cyl. + W_s	g	336,88	336,43	337,02
Cyl.	g	238,70	238,70	238,70
W_s	g	98,18	97,73	98,32
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,5537	0,5649	0,5568

LØS LEJRING 3

Prøve	nr	3	3	3
A (10,0/ 38,48)	cm^2	10	10	10
h (7,0/14,4)	cm	7	7	7
V (70,0/554,0)	cm^3	70	70	70
Cyl. + W_s	g	339,12	339,58	338,20
Cyl.	g	238,70	238,70	238,70
W_s	g	100,42	100,88	99,50
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,8333	0,8249	0,8503

FAST LEJRING 3

Prøve	nr	3	3	3
A (10,0/38,48)	cm^2	10	10	10
h	cm	5,820	5,820	5,825
V	cm^3	58,20	58,20	58,25
Cyl. + W_s	g	336,48	336,75	336,60
Cyl.	g	238,70	238,70	238,70
W_s	g	97,98	98,05	97,90
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,5654	0,5611	0,5648

LØS LEJRING 4

Prøve	nr	4	4	4
A (10,0/ 38,48)	cm^2	10	10	10
h (7,0/14,4)	cm	7	7	7
V (70,0/554,0)	cm^3	70	70	70
Cyl. + W_s	g	338,43	338,64	338,99
Cyl.	g	238,70	238,70	238,70
W_s	g	99,73	99,94	100,29
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,8460	0,8421	0,8496

FAST LEJRING 4

Prøve	nr	4	4	4
A (10,0/38,48)	cm^2	10	10	10
h	cm	5,745	5,805	5,750
V	cm^3	57,45	58,05	57,50
Cyl. + W_s	g	335,64	335,74	335,09
Cyl.	g	238,70	238,70	238,70
W_s	g	96,94	97,04	96,39
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,5586	0,5733	0,5689

LØS LEJRING 5

Prøve	nr	5	5	5
A (10,0/ 38,48)	cm^2	10	10	10
h (7,0/14,4)	cm	7	7	7
V (70,0/554,0)	cm^3	70	70	70
Cyl. + W_s	g	338,42	338,85	339,57
Cyl.	g	238,69	238,69	238,69
W_s	g	99,73	100,16	100,88
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,8460	0,8381	0,8249

FAST LEJRING 5

Prøve	nr	5	5	5
A (10,0/38,48)	cm^2	10	10	10
h	cm	5,755	5,745	5,750
V	cm^3	57,55	57,45	57,50
Cyl. + W_s	g	335,38	335,78	335,27
Cyl.	g	238,69	238,69	238,69
W_s	g	96,69	97,09	96,58
$e = \frac{d_s \cdot \rho_w \cdot V}{W_s} - 1$		0,5654	0,5562	0,5658

Specific Gravity

RELATIV DENSITET

		1	2	3	4	5
Prøve	nr	Sæk 1	Sæk 2	Sæk 3	Sæk 4	Sæk 5
Pyknometer	nr	100	103	100	103	103
Pyk ind/ud ekssikkator	kl	17/1-2018 Ind 09:00 Ud: 10.30	17/1-2018 Ind 09:20 Ud:10:30	19/1-2018 Ind: 08:30 Ud: 10:00	19/1-2018 Ind: 09:30 Ud: 10:30	19/1-2018 Ind: 13:00 Ud: 14:15
W_1 $(W_{pyk} + W_s + W_{vand})$	g	709,315	734,415	709,250	734,405	734,200
Temperatur t	°C	19,3	19,3	18,0	18,1	19,0
W_2 $(W_{pyk+vand})$	g	616,155	641,270	616,250	641,370	641,245
Bægerglas	Nr	100	701	106	601	Rød
Bæger ind varmeskab	d. kl	17/1-2018 10:45	17/1-2018 11:00	19/1-2018 11:00	19/1-2018 11:30	19/1-2018 15:00
Bæger ud varmeskab	d. kl	19/1-2018 10:00	19/1-2018 10:00	24/1-2018 10:00	24/1-2018 10:00	24/1-2018 10:00
$W_{bgrglas} + W_s$	g	418,575	398,050	672,365	591,475	612,895
$W_{bgrglas}$	g	268,430	248,060	522,440	441,520	462,970
Tørstof W_s g		150,145	149,990	149,925	149,955	149,925
Vands densitet ρ_w^t g/ml		0,99830	0,99830	0,99862	0,99862	0,99843
Relativ densitet $d_s = \frac{W_{s\cdot} \cdot \rho_w^t}{W_s + W_2 - W_1}$		2,6278 ~2,63	2,6341 ~2,63	2,6301 ~2,63	2,6322 ~2,63	2,6275 ~2,63

DESTILLERET VANDS DENSITET ρ_w^t

°C	10	11	12	13	14
g/ml	0,99973	0,99963	0,99953	0,99941	0,99927
°C	15	16	17	18	19
g/ml	0,99913	0,99897	0,99880	0,99862	0,99843
°C	20	21	22	23	24
g/ml	0,99823	0,99802	0,99780	0,99757	0,99733
°C	25	26	27	28	29
g/ml	0,99708	0,99681	0,99654	0,99626	0,99598